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POTATO GROWING IN KENTUCKY

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The Irish potato has been an important cash crop in some parts of the state for many years and a valuable side crop in many others; even where potatoes are not important as a commercial crop, most farmers grow their home supply. Kentucky ranks second among the southern states in the value of its potato crop, exceeded only by that of Virginia; and Jefferson county, the leading county in potato production in Kentucky, is well known for the excellence of its "second" crop, grown as seed for the southern states.

Statistics dealing with the present potato industry in Kentucky point to possibilities for its enlargement, both in the sections conceded to be favorable in soil and climate, and in some others where the conditions are not so favorable. Many markets are under-supplied with home-grown potatoes, markets surrounded by territory in which the crop can be made to flourish; and even where the commercial posibilities of the crop are limited, every farmer should be able on some portion of his farm to grow enough potatoes for his own use.

Potatoes may be grown on any type of soil that contains organic matter in quantity sufficient to make it retentive of moisture and at the same time loose enough to allow easy root penetration and free formation of symmetrical tubers, but natural sandy loams are best. The character of the subsoil is important; it should be well drained, for the Irish potato cannot do its best in cold, water-logged soils. The best yields are obtained where the sub-soil contains sufficient sand or gravel to be well drained, but extremely loose subsoils are unfavorable to a potato crop in dry weather.

*The general arrangement of the material contained in this circular, as well as its gathering are the work of the senior author, the junior author having assisted in its final arrangement and editing.

SOIL MANAGEMENT

Humus: An important part of potato soil management is the maintenance of its organic matter or humus content. This is taken care of when the potatoes are grown as part of a good farm rotation in which this crop follows grass or clover. Where the rotation is too short or the land value so high as to prohibit growing a sod, green manure crops grown between seasons, or heavy applications of manure, serve as substitutes. Apart from furnishing organic matter a good rotation in which potatoes occur at proper intervals had best be used since, if potatoes follow potatoes too closely, an accumulation of potato diseases is quite certain to take place.

Stable manure as a source of humus, whether composted or fresh, is not always to be recommended. To use it composted is costly, since from a quarter to one-half the organic matter is lost in composting, while to use it fresh is dangerous, because of its tendency to increase scab. It may be said, however, that for the gardener whose aim is to keep his land fully occupied thruout the growing season with crops whose value is many times that of a green manure crop, there is nothing to take the place of well-rotted manure as a source of humus on potato land, particularly when the early crop is grown.

Green manures afford a very effective means for building up the humus content of soil. Aside from the fact that green manure crops grown between seasons furnish the cheapest and most easily applied form of humus, their use minimizes the loss of plant food thru leaching, lessens the danger of winter soil-washing and appears to have a somewhat corrective effect on land infected with potato scab. Since both leguminous and non-leguminous cover crops are available, and in each class, both hardy and tender kinds are found, a choice wide enough to meet any conceivable condition is afforded the potato grower.

Green manure crops to be used on land for first-crop potatoes should be sown early in the fall, in order that they may make sufficient growth by early planting time, usually some time in February. The following are satisfactory examples:

Hairy vetch, 1 bushel, sown August 1 to September 1.
Hairy vetch, 30 lbs. and rye 1 bushel, sown August 1 to Sept. 1.
Crimson clover, 10 pounds; hairy vetch 30 pounds, August 1 to 15.

Green manure crops to be used for the late potato crop have ample time to decay, and may accordingly be sown later than those for early potato land. Their sowing may be delayed until after the harvesting of a late crop of potatoes, tho such late sowing is not recommended, unless unavoidable. The crops to use may be:

Vetch alone, sown as late as September 15.
Vetch and rye, sown not later than October 1.
Rye alone, 2 bushels, sown as late as November 1.
Crimson clover, 20 pounds, sown July 15 to August 15.

Or, when fall planting has been delayed so much as to make success doubtful,

Oats, 1 bushel and Canada field peas, ½ bushel, sown in March, may be used.

The best time to plow under these crops is when the oats or rye are just beginning to head, or the clover or vetch to bloom. After this time these crops begin to turn woody, making their decay slow when plowed under, resulting in droughty land in a dry season.

Breaking Ground: The range of climate in Kentucky is such that no fixed time for breaking ground to apply everywhere within the State, can be given. Since, however, a sod or cover crop must partially decay in order to supply humus or plant food, it must be turned under in time for this change to take place. Generally speaking, fall breaking or early spring breaking is best for early potato land, especially with heavy soils, and late spring breaking for the late crop. It is always good practis to disk the land thoroly before breaking, whether there is any plant growth to turn under or not. This, together with the harrowing done after breaking, will insure a deep seedbed such as potatoes need. The depth of plowing will depend on the depth of topsoil; it is not wise to turn up more than one inch of subsoil at any one time. Subsoiling may be of advantage in exceptional cases, but care should be taken usually not to disturb even moderately loose subsoils and certainly not those of a gravelly or shaly nature, for the subsoil constitutes an important moisture reserve which should not be broken up.

MANURES AND FERTILIZERS

A large crop of potatoes removes a considerable amount of plant food from the soil, making the cost of fertilizing one-fourth to one-half the total expense of producing the crop and, since the price of potatoes is so variable, profit may be turned to loss, if fertilizing is not done discreetly.

Nitrogen: The application of nitrogenous fertilizers on potatoes needs to be done cautiously since, if an excess of nitrogen is used, rank and succulent top growth and a light set of tubers will result. On the other hand a prompt and vigorous top growth is necessary to produce a good crop of early potatoes and such growth is mainly obtained thru a sufficient supply of nitrogen.

When sod, topdressed with manure, or a cover crop of legumes is turned under the nitrogen needs of the crop will be adequately met, provided the plowing can be done long enough before planting for the nitrogen in the cover crop or in the manure to become available for the use of the potato crop. For late potatoes planted in midsummer an interval of two months may suffice for the purpose, but for early potatoes the weather is usually too cool for the nitrogen in manure or in a cover crop to become available for plant use in sufficient quantity and early enough to benefit the crop very much. For the early crop, then, it is good practis to supplement the manure or other plowed-under matter with nitrogen from nitrate of soda or sulfate of ammonia, at the rate of 150 to 200 pounds per acre to start off the crop. If there is a shortage of nitrogen in manure or in legume form, a slowly available nitrogen carrier should be added besides, as for instance, from 200 to 400 pounds of cottonseed meal or of fertilizer tankage, to carry the crop along after the quick acting nitrogen has been spent.

Phosphorus: Phosphorus is a limiting factor in producing a good potato yield thruout Kentucky, except in those parts of the Bluegrass region where the soil is very rich in this element. The main carriers used to supply this element are bone meal and acid phosphate, while in some sections of the state Thomas slag is used by some growers.

Potash: Potatoes need potash, giving indication of a shortage of this element by a coppery coloring of the foliage and a generally weak appearance, with a correspondingly low yield. Analyses of numerous samples of Kentucky soils show that, except in the case of overflow land in river and creek bottoms, sufficient potash is present to grow several hundred crops of potatoes, but demonstrations conducted in potato growing centers, indicate that the question of potash supply is not so easy of disposal as the analyses suggest.

Soil potash is made available thru the breaking down of green manure crops as a result both of the chemical action attending this decay and of the return to the soil of potash extracted by them. Potash may be added thru the application of stable manures, straw, tobacco stems and potash salts. When any but the last named carriers are used, time should be allowed for decay to begin so that their potash is made available. Of the two potash salts, sulfate and muriate, the former is the better to use.

Method of Applying Fertilizer: Since the root system of the potato is restricted, much of the fertilizer which is applied broadcast is lost to that crop at least. It has accordingly been the practis in northern potato states to apply part of the fertilizer broadcast and part in the row. Recent reports from New Jersey and Connecticut Stations show that the best results were had when the fertilizer was applied at planting, one or two inches to either side of the seed piece[1], even when as high rate of application as 1,800 pounds per acre was used.[2]

Potato Fertility Suggestions: Differences in Kentucky soils and in their management make recommendations as to fertilizing practis to cover every case unsafe. In the past few years demonstrations of fertilizing practis, as regards method and kind, have been carried on in the potato growing centers, which should serve to point the way to the proper method of fertilizing potatoes. The grower should bear in mind the fact that the exact practis satisfactory for his case may only be arrived at

[1] J. G. Lipman, N. J. State Potato Ass'n (monthly bulletin), January, 1922.

[2] Wm. H. Martin, N. J. State Potato Ass'n (monthly bulletni). March, 1922.

thru experimenting done by himself. The general recommendations follow:

Acid phosphate, as furnishing phosphorus in the most readily soluble form, is the best carrier of phosphorus to use on potatoes.

All fertilizers should be applied in the row, to either side of the seed-piece rather than above or below it, but in no case touching it.

For the early crop, if as much as 10 tons of manure, somewhat rotted, is applied, add 600 pounds of acid phosphate, with 100 to 200 pounds of nitrate of soda or sulfate of ammonia.*

If a cover crop devoid of legumes is turned under, use 800 pounds of 4-10-0, or 4-8-4 or a home-made mixture as follows:

Nitrate of soda, 200 pounds or sulfate of ammonia, 150 pounds.
Tankage or cottonseed meal, 200 pounds.
Acid phosphate, 500 pounds.
Sulfate of potash, 50 pounds.

For the late crop, if a cover crop of legume is used, add acid phosphate 600 pounds. If the cover has no leguminous content, a liberal topdressing of manure would remedy the nitrogen shortage, tho at too high a cost. Applying 4-10-0 fertilizer at from 800 to 1,200 pounds per acre would serve well where a cover crop was absent or devoid of legumes.

Phosphate is not needed on the very phosphatic soils of the Bluegrass region, when they are in good condition.

SEED

Probably more failures to secure satisfactory potato yields can be traced to the use of poor seed stock than to any other single cause, for, even if fertilization and general management are right, yet, if the mistake has been made to use seed of questionable origin, poorly stored and improperly cut, a profitable yield cannot result. Demonstrations thruout Kentucky annually prove that to use any seed potatoes but those whose performance as to yield and quality is known, is poor economy no matter how low in price the seed; superior seed is always worth a premium.

*New Jersey Station results show that when the nitrogen carrier is sulfate of ammonia, a measurable control of potato scab is had.

Certified Seed: The simplest way to make sure of satisfactory seed potatoes is to use only certified seed. The word "certified" means that the stock has been inspected by representatives of the College of Agriculture for disease, in the field and in the bin, and that the percentages of the important diseases are negligible. That such seed will produce superior crops has been proved in over two hundred demonstrations thruout Kentucky, in which certified seed gave an average of 40 per cent more potatoes than did the common stocks. Certified stock does not stay "certified" indefinitely, but may take any of the diseases to which potatoes are subject, unless steps are taken to maintain the original freedom from disease and general superiority. Original packages of certified seed are sealed and bear tags as guaranty of certification.

General Characters: Good seed potatoes should not be larger than 12 ounces, for large potatoes cannot be cut economically into pieces of the proper size and conformation. Moreover, if the seed is so large that each piece bears but a single eye, the seed pieces bearing the first and sometimes even the second eye from the stem end may result in missing or weak hills, because of the low vitality of these eyes. On the other hand, to use small seed planted whole, unless known to be of productive stock, is to invite low yields, for small potatoes are frequently the progeny of diseased and weak hills. The ideal seed potato weighs 6 ounces and should be cut into four pieces.

Good seed potatoes should be reasonably free from common scab (see page 46) and black scurf (see page 46), but even if these diseases are present the seed can be treated (see page 43) and if the potato land is not previously infected, a clean crop will result. Even when seed is apparently clean, treatment always should be given, whether the seed is purchased or home-grown, to guard against the introduction or spread of disease.

Seed potatoes should be true to type, not knobby or showing "spindle tuber" (see page 52) characteristics. On cutting across the stem end the flesh should show no ring discoloration (see page 51) or net necrosis (see page 51) since such a condition often indicates disease.

Storage: Seed potatoes, as well as those intended for table use, must have been stored under conditions cool enough to prevent sprouting or wilting. On the other hand, sustained temperatures below freezing may result in chilling, causing slow and weak sprouts, when used as seed. The storage temperature for the first few months after digging, the normal rest period of the potato, may be as high as 40 to 45 degrees Fahrenheit, but for the late spring and summer storage, as for late crop seed, it should be held approximately at 35 degrees Fahrenheit.

A house cellar may serve for storage, particularly if there is no furnace to raise the temperature unduly high and lower the humidity to such a point as to induce wilting. Every precaution should be taken to exclude all light from stored potatoes designed for eating stock, as even the pale light reflected from whitewashed walls will tend to green them, destroying the original flavor. Figure 1 illustrates a simple potato pit. This form of storage is quite effective for both eating and seed stock, if care is taken to provide ventilation until after the "sweating" in the early part of the storage period is over and to guard against any sudden fall in temperature after that. To provide ventilation all that is necessary is to leave off the earth-covering of the extreme top of the pile, thus permitting the escape of the warm, moist air.

Fig. 1. A Potato "Pit" or "Hill."

Fig. 2. A potato cave, built into a hillside.

Fig. 3. A concrete hillside potato cellar with sweet potato storage house on upper floor.

Another form of storage is illustrated in Figure 2.

A more readily controlled storage structure is shown in Figure 3.

In such storage seed potatoes may be kept in good condition until March, at which time the seed for the late crop is put into cold storage; this is particularly true when any of the early varieties such as Cobbler or Early Ohio are used. Growers who use the McCormick or Green Mountain or Bull Moose varieties frequently depend on common storage to keep their seed potatoes until planting time in July, with generally favorable results, but even when these varieties are used seed kept in cold storage will give superior crops.

Cutting the Seed: Seed pieces should be blocky rather than thin or narrow, since blocky pieces have relatively small cut faces thru which "bleeding" and consequent wilting of the seed piece may take place. One eye placed far enough away from a cut surface to guard against its weakening thru bleeding is sufficient, but a large number of eyes per seed piece is not objectionable. Hills in which there are an excessive number of sprouts

Fig. 4. Two Methods of Cutting Seed Potatoes.

result from diseased seed pieces rather than from pieces bearing the bud cluster of eyes. A healthy group of eyes will give rise to a normal number of sprouts. Seed pieces 1½ ounces in weight usually have been found satisfactory to plant, tho some growers and experiment station workers have secured larger yields with two ounce seed pieces. The bud end piece bearing a group of eyes may weigh as little as one ounce, tho 1½ ounces is not too large in adverse growing seasons.

While the seed is being cut, it is of advantage to dust it with flour of sulfur. Sulfur causes bleeding to stop and favors the healing of cut surfaces; it appears to have a deterrent effect on the rot organisms in the soil, which are particularly active in the hot, dry weather that generally prevails at planting time for the second crop, and its continued use may act as a check on potato scab. Ten ounces will dust a bushel of seed. Using an excess over this amount is wasteful, besides causing discomfort to the operator of the planter.

Maintaining Good Seed: Even if certified seed or other superior stock is secured at the start, it will not long remain superior unless steps are taken to maintain its vigor and general excellence. The means to secure that end is selection in some form. The most simple practis is to dig the best hills to use for seed. This method will go far in keeping seed from "running out," and may even result in improvement, tho improvement from following this method would be slow.

A much better way to maintain seed and to improve it as well is the "tuber-unit" method, with modifications. This method consists in selecting tubers of desirable conformation, quartering them endwise so that each piece will have a similar assortment of eyes, and planting them in such a way that the plants growing from each seed piece and each group of seed pieces cut from the individual tubers may be studied separately. Instead of allowing each hill to mature and taking appearances at digging time as the sole measure of excellence, each hill is observed closely as soon as it comes up, and any unit which contains a plant subnormal in any way is forthwith pulled out, so that no opportunity is afforded for spread of disease to healthy

units. Digging records are taken and only the high-yielding units are retained. If the tuber-unit plot is removed at least 200 feet from any other potatoes, the units surviving are in all probability superior and should make excellent foundation stock which could be further improved by continued tuber-unit selection, or maintained at a reasonably good standard for a time by hill selection in the field.

A very effective way to maintain high yield is the method used in certification. Only stocks known to be good to begin with are admitted, and they are subjected to close scrutiny and continuous rogueing of all abnormal plants, whether due to disease, low vigor or varietal mixture. The best hills are thus left and if rogueing is done in time and thoroly enough, the percentage of disease left in such a field is low.

PLANTING

Whether to use a planter or not, is a many-sided question. If depreciation and interest on investment alone are taken into account, it is doubtful whether an acreage of less than 10 can support a planter economically, but when it is recalled how important timeliness of planting may become, especially in the early crop planting season when favorable days are few, a planter

Fig. 5. A Two-Man Potato Planter.

used on as few as 4 acres sometimes may be a profitable investment. When, too, the economy and increased efficiency attending the correct application of fertilizers as effected by the fertilizer attachment on a planter are considered, the smaller acreage may easily make a planter pay.

There are two types of planters, one (Figure 5) in which a man besides the driver is needed to see to it that the hopper is fed properly, the other (Figure 6) in which the machine auto-

Fig. 6. A One-Man Potato Planter.

matically picks up seed pieces, one by one, and drops them. A point in favor of the picker planter is its light draft; on the other hand the picker is not always effective when whole seed or seed not uniformly cut is used.

The two-man, or "plate," planter has relatively simple machinery and this is an important point. A point against it, however, is that the speed of the attendant in keeping the plate properly supplied with seed pieces will determine the speed at which the planter may travel; the "picker" planter will operate satisfactorily at a speed limited only by the speed of the team and can keep it up all day.

Whatever type of planter is chosen, it should be equipped with a fertilizer distributor which, as experimental data indicate, should release the fertilizer to either side or both sides of the seed piece, removed from it by about an inch and on the same plane rather than above or below it. The seed and fertilizer shoes should be designed with as little side or vertical play as possible, to insure even covering and, in consequence, an even stand.

In the absence of a planter a turning plow or a single shovel plow may serve. In such a case the fertilizer is dropt in to the furrow by hand, and a piece of chain or a block of wood dragged thru it to mix the fertilizer with the soil. This is important in case fertilizer containing nitrogen or potash is used, for either of these touching the seed may cause wilting to the extent of stunting the sprouts and prevent a satisfactory stand. Following the fertilizer the seed is dropt and covered with a plow. Throwing two furrows over the seed is generally preferred, as the extra covering guards against late frost and freezing injury to the early crop, and in the case of the late crop is effective in aiding the rise of soil moisture around the seed and in keeping it somewhat cooler than when the covering is shallow. In either case the ridge is dragged down before the sprouts come thru, leaving a cover of two to three inches; this constitutes the first cultivation which usually takes care of any weeds that may have started.

Planting Distances: The width of potato rows is determined partly by the ideas of the grower and partly by the variety; large-topped varieties as Bull Moose, Hoosier Boy and Carman need more room than the upright varieties. Thirty to thirty-six inches is sufficient range to cover most cases, tho some growers use twenty-six. The closeness of planting in the row is likewise governed by the nature of the top-growth, by the fertility of the soil and by the use to which the crop is to be put, whether for seed or for eating stock. In rich land and when small average size is desired close planting is advised; in other cases longer spacing is better. The range is from nine or even six inches to fifteen.

Amount of Seed Per Acre: If seed pieces weighing 1½ ounces are used, the following rates of spacing will require the quantities of seed shown below:

Inches width of Row	Inches Sp'cg in Row	Bus. per Acre Req'd	Inches width of Row	Inches Sp'cg in Row	Bus. per Acre Req'd	Inches width of Row	Inches Sp'cg in Row	Bus. per Acre Req'd
26	6	63	30	6	55	36	9	31
26	9	42	30	9	37	36	12	23
26	12	31.5	30	12	27.5	36	15	18.5
26	15	25	30	15	22	36	18	15.5
			30	18	18	36	21	13
			30	21	16	36	24	11.5

Planting Time: The early crop is planted as early as the ground can be prepared. In especially early land and in the southern part of the state, this may be as early as February, tho a comparable gain in earliness of the crop does not always follow. In normal years March is the month in which most early potato planting is done, frequently carrying over into the first and second weeks of April; except in an abnormally cool spring, planting after this time does not give maximum early crops in Kentucky.

The late crop is planted from July 15 to August 15, when Irish Cobbler or Bliss Triumph are the varieties used. Planting time for Bull Moose, Green Mountain, Russet Rural and McCormick ranges from July 1 to July 15.

CULTIVATION

Proper cultivation plays an important part in successful potato growing and mistakes in this regard may prove very costly. After the ridges have been dragged down the middles need stirring, both to put the land in order for later cultivation and to discourage any weeds that may have started. This may be done with a single shovel, tho a three-point or five-point culti-

vator is better. This cultivation may be deep and fairly close to the rows, but later ones should be shallow and far enough from the rows to make certain that no roots are cut. The best tool to use is the fourteen-tooth cultivator.

When the tops have made so much growth that cultivation must soon cease, a finishing cultivation called "laying-by" by some growers, is given. This operation may mean anything, from throwing a decided ridge with a turning plow to dragging toward the rows a very much lower one by means of a simple board drag. Since success is had with both extremes of "laying-by," it would seem as if any type would do but, generally speaking, a high ridge is best used on the early crop when moisture abounds, and in poorly drained land; the lower ridge or even level cultivation is the one to use on the late crop when droughts are apt to occur.

DIGGING

Dates for digging vary with the section of the State tho usually the early crop is dug slightly immature so as to get on the early market. The second crop is generally dug after the vines are killed by frost; very few potatoes remain undug after November 1 in an average year. If there has been a visitation of blight (page 47) or wilt (page 50) or if the vines have been killed thru any other agency, it is well to lose no time in getting potatoes out of the ground, particularly if wet weather is expected.

The method to be used in digging may range from the employment of a "grabbling hook" to that of an engine-driven digger. Sometimes it is important to get digging done in a hurry; if the hoe or the potato fork are used a considerable force of diggers is needed and, while the tools are inexpensive, the labor employed may make this method of harvesting the crop quite an expensive one in the end.

Where the ordinary turning plow is used, many potatoes may be lost unless the pickers take time and care in gathering them and even then, the next rain will usually disclose many potatoes that have been overlooked. Better than a turning plow

Fig. 7. A "Middle-Buster" or Middle Breaker, Sometimes Used in Digging Potatoes.

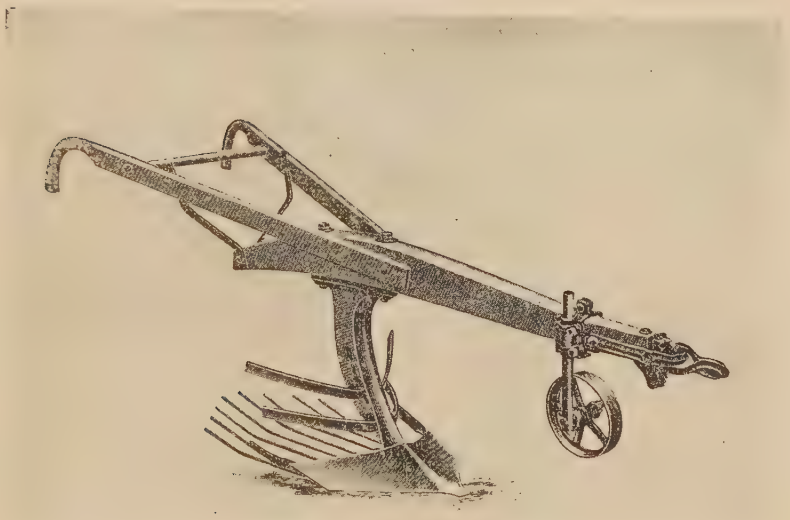

Fig. 8. A Potato Plow.

is a digger plow, one type of which is illustrated in Figure 8. Such a plow may be bought at a moderate price and the work it

does is usually quite satisfactory. The next better type of digger is the traction-driven elevator digger, which has guides for depositing tops and weeds in windrows beside the rows, and the potatoes are shaken free of any soil in a narrow pile, easy to see and pick up.

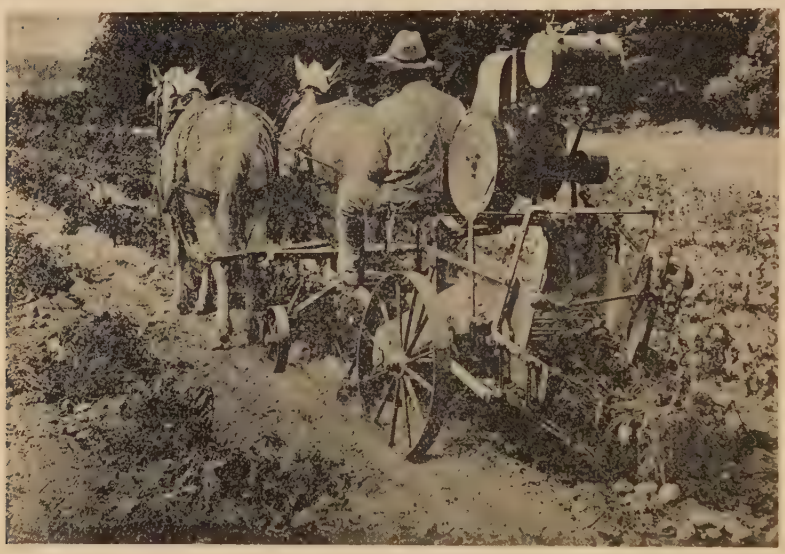

Fig. 9. A Power-Driven Elevator Potato Digger

The best type of digger is one in which the apron is operated by a gasoline motor, saving the horses which draw the digger considerable labor. Such a digger is illustrated in Figure 9. When economy of time in digging and of labor saved are taken into account, a yearly planting of ten acres will make ample returns on an investment in an elevator potato digger.

POTATO INSECTS AND DISEASES

Due to the mild weather that prevails in at least some parts of the State, insects and diseases winter over readily and potato growers dare not overlook them. Tho an exhaustive discussion

of this subject cannot be entered upon here, a list of the important pests and their control is given.

Insects: The chewing insects that cause defoliation are the Colorado potato beetle, the blister beetles, the tobacco worm, and occasionally the cabbage worm and army worm do some damage. All these pests may be poisoned by spraying with either of the following mixtures, per acre:

1. Calcium arsenate powder, 4 lbs.; hydrated lime, 4 lbs; water, 100 gals.
2. Lead arsenate powder, 4 lbs.; water, 100 gals.
3 Paris green, 3 lbs.; hydrated lime, 3 lbs; water, 100 gals.

Or, dust mixtures, ready made or compounded by the grower, as follows, may be applied, per acre:

Lead arsenate, 4 lbs.; hydrated lime, 40 lbs. or
Calcium arsenate, the same or
Paris Green, 4 lbs. and hydrated lime 4 lbs.

Fig. 10. A compressed-air Sprayer.

Fig. 11. An atomizer sprayer, for a small garden.

Another chewing insect is the black flea beetle, control for which is spraying with Bordeaux mixture (page 48) and arsenate.

The sucking insects that infest potatoes are the lice, the potato leaf-hopper and sometimes the white fly. The injury the lice do would be small if it were not for the spread of the "running-out" diseases of potatoes they effect. Altho the white fly is apparently not guilty in this respect, a severe infestation apparently constitutes a severe drain on the vitality of the plant. For the control of lice, some form of tobacco extract is indicated, either liquid or dust. Proprietary preparations of both forms

Fig. 12. A horse-drawn spray rig.

are in the market and if used in time are effective. The leaf hopper is controlled by spraying with 5-5-50 Bordeaux mixture, as a repellant.

Diseases: Potato diseases are of two kinds; those borne on or in the seed, and those contracted in the field. The former list includes common scab and black scurf, control for which is proper seed treatment as explained below; the latter and the so-called "running-out diseases" are discust later. The diseases potatoes may take in the field are common scab, black scurf, wilt and blight, control for which is discust under the proper head.

Common Scab; Seed Treatment: The procedure is to soak the tubers, preferably unsprouted and uncut (tho cut and healed-over seed potatoes show no ill effects from soaking), in a solution made of water, 22½ gallons, and corrosive sublimate, 3 ounces. The sublimate dissolves very slowly in cold water; it is best to dissolve it in two quarts of boiling water, in anything but a metal container, and add it to the 22 gallons of water in a 50-gallon barrel, in which this amount of solution will just rise to the top when the barrel is filled with potatoes. Each batch of

the solution may be used in succession for four lots of potatoes which are soaked for the time indicated below:

Lot No. 1—1 hour.
Lot No. 2—1 hour, 15 mniutes.
Lot No. 3—1 hour, 30 minutes.
Lot No. 4—2 hours.

The solution is then too weak for further use and a fresh solution must be substituted. The apparatus for doing the work need not be elaborate. If barrels are used they should be set on a support about twenty inches high and each should have at the base a hole, supplied with a plug, thru which the liquid is drawn off into buckets or tubs, after the proper soaking interval has elapsed. The potatoes are then dumped on the ground or preferably into crates or slatted barrels to dry The potatoes should always be soaked in bulk; soaking them in sacks wastes liquid in that space is wasted; the sacks, besides, have a tendency to absorb the chemical to such an extent that the strength of the solution cannot be depended upon.

Fig. 13. An effective seed-treating plant.

An efficient plant for treating large quantities of potatoes may consist of a number of barrels filled with potatoes soaking in the corrosive sublimate, and an extra barrel left empty. After the potatoes have soaked for the proper time in barrel "number one," let us say, the liquid is drawn off and put into the extra barrel and that filled with potatoes to be soaked. The treated potatoes are then dumped from the first barrel and liquid drawn into it from barrel number two and a new lot of potatoes put in. Similarly, barrel number two after being emptied of treated potatoes is refilled with potatoes to be treated, and the solution from barrel number three put in, and so on in rotation. Each barrel should bear a card on which the time at filling should be noted and also the number of times that particular lot of solution has been used. Eight barrels of potatoes and solution and one empty one will keep one man fully occupied and, assuming that 50-gallon barrels are used, the plant will permit of handling 250 bushels of potatoes in a ten-hour day.

Another type of treating plant consists of a shallow tank of wood or concrete, of such dimensions as to accommodate without waste of space, either standard crates or some made for this purpose, and of such a depth that these crates may be immersed and no more. This method does away with one handling of the potatoes, for the potatoes will dry nicely in the crates in which they are soaked, and the crates themselves are also thus made sterile.

Corrosive sublimate is extremely poisonous and great care should be taken that no live stock can get at the used solution, or eat treated potatoes thrown out for any reason.

Another way of treating seed potatoes in large quantities is to soak them for two minutes in a solution of water 30 gallons and formaldehyde 2 pints, at a temperature of between 118 degrees and 122 degrees Fahrenheit, carefully maintained. This mode of treatment calls for a special piece of apparatus but, when large quantities of seed are to be treated, as for a seed association or a produce company, its use may profitably be considered.

Common Scab; Land Treatment: Potato scab is caused by an organism found in the soil and even tho the seed potatoes have been treated a scabby crop may follow, particularly when the weather is hot and dry at tuber-setting time. The scab organism thrives best in a sweet soil, as many growers know who have grown scabby crops on limed land; the control obviously is to make such land acid, by some means.

New Jersey Experiment Station has found that if ammonium sulfate is used as a carrier of nitrogen in potato fertilizer, cleaner crops result than when nitrate of soda is used. The ammonium sulfate leaves behind sulfuric acid whereas sodium nitrate leaves sodium carbonate, which tends to make land alkaline.

Another means of introducing acid to land is to apply sulfur in some form. Many Experiment Stations are studying this method but no uniform results have so far been secured. One thing appears to be certain, that the quantities and kinds of sulfur to be used are governed by the individuality of the soil itself; while land treatment with sulfur has merit, it behooves the grower to approach this practis advisedly, particularly if onions, salad crops or the grasses are grown in rotation with potatoes, because rendering land acid may reduce the yields of these crops.

Black Scurf: A plant suffering with the black scurf usually is undersized, tho even if it is not, it discloses the fact that it is diseased by the peculiarity of its habit of growth; the branches of an affected plant tend to point upward like those of a Lombardy poplar. Close inspection of such a plant will disclose the characteristic brown or black diseased spots on the stem either close to the ground line or below it. Another common symptom easily discerned is the tendency to bear tubers above ground. If the number of such plants is small, they may be taken out and seed contamination somewhat reduced. A plant suffering from black scurf usually produces only small potatoes, and the tubers may show dark brownish or blackish, felt-like masses, called sclerotia, which have the general appearance of soil particles clinging to the skin of the tuber. Seed treatment as for common scab (page 43) is entirely effective.

The Potato Blights and their Control: Before discussing the matter of blight control, it may be well to point out the difference between the blights and the wilt, because these diseases are frequently confused.

The blights are foliage diseases, beginning with spotting of the leaves. In the early blight, these spots are dry; in the late, they are water-soaked and surrounded by a fuzzy growth on the under side of the leaf. In the early form the spots grow in all directions and show concentric growth rings; in the late, the spots spread across the leaf. In both, the leaf tissue ultimately is destroyed and the crop curtailed, with the additional menace, in the late blight, of tuber rot infection by organisms which abound in the decayed leaves and vines which, by the way, give off an odor always associated with the late blight. Kentucky lies south of the late-blight belt, tho occasionally slight attacks might occur here.

The potato wilt, on the other hand, attacks the plant from the inside, affecting the tissues. The disease may be seed-borne, in which case it may make its presence known by a brown ring discoloration at the stem end of the seed potato, easily discernible at cutting, or it may have accummulated in the soil because of potatoes having followed potatoes too closely or for too long a time. The first symptom in the field is a droopy appearance of the plants, which may be attributed to drought or to hot weather. The plants revive overnight to droop the next day and the next, always earlier in the day, until they fail to come back to normal at all. The leaves turn yellow and drop off and the plants finally dry up. There is no help for wilt in the field; the remedy is to plant no suspected seed and to rotate the crop.

For either form of blight the method of control is spraying with Bordeaux mixture (see page 48). The first spray application should be made just after the plants are all above ground and at ten days or two weeks intervals thereafter until four sprays have been given, and a fifth if it is possible to go thru the rows without injury to the tops.

Spraying: The main essential in effective spraying is good covering, particularly when spraying with Bordeaux mixture, in

which case the under surfaces as well as the top surfaces of all foliage, should be covered; this is effected by proper nozzle adjustment and sufficient pressure. The ideal way to provide both is to use an engine-driven sprayer or a traction driven sprayer with a pump of at least two cylinders; better, three.

The pressure at which the spray is delivered is important, and so are the adjustment and inclination of the nozzles and the maintenance of the nozzles themselves. Good results have been had with pressures as low as 125 pounds per square inch, using strained Bordeaux mixture, the nozzles carefully adjusted to cover the rows and the nozzle disks new. With a pressure of 200 pounds per square inch good covering and a minimum of trouble from stopped nozzles are assured, but such a pressure cannot be maintained by any rig short of an engine-driven pump or a good three-cylinder traction-driven one.

In the case of small plantings, less than an acre, an elaborate sprayer will cost too much to operate and maintain, and the grower must have recourse to pumps of a similar type. Hand-operated barrel pumps mounted on skids or axles or even in farm wagon bodies, may be used and wheelbarrow-type sprayers may do good work; then follow the various kinds of hand-carried sprayers. Good work may be done with these relatively simple means but extreme care must be taken to have the spray material reach each part of the plant; the higher nozzle pressure provided by the more elaborate sprayers will correct minor mistakes in nozzle direction and adjustment.

The larger types of rigs, in proper adjustment, will apply 100 gallons of spray per acre; hand outfits, under skilled operation, may cover an acre with less, but their saving of spray material does not offset the vastly increased amount of labor and time necessary when they are used.

Making Bordeaux Mixture: Bordeaux mixture is a combination of lime, copper sulfate and water. Many methods for making Bordeaux safe are advocated but the foliage of the potato, fortunately, is rather resistant to Bordeaux burn and the method here suggested is safe for potatoes, if not for all crops. The steps are:

1. Slake in a 50-gallon barrel 50 pounds of fresh stone lime, adding water in small quanties, so as to prevent "drowning." When slaking is accomplished, fill the barrel with water. If stone lime is not available, hydrated (not air-slaked) lime may be used, but the quantity must be increased by half, that is, 75 pounds of hydrate to 50 gallons of water. This is the lime stock solution.

2. Dissolve in a 50-gallon barrel of water, 50 pounds of copper sulfate (bluestone, not copperas). If the bluestone is put into a sack so hung that only 2 or 3 inches is immersed in the water it will dissolve overnight, but this solution should be stirred to make it uniform; or dissolving may be hastened by crushing the larger crystals and using warm water. This is the copper sulfate stock solution.

3. To make 50 gallons of 5-5-50 Bordeaux mixture, put into the sprayer tank 40 gallons of water, add 5 gallons of lime stock solution, stirred and screened, and then 5 gallons of copper sulfate stock solution, and stir vigorously. If lead arsenate or calcium arsenate is to be put in for insect control, the proper amount of poison (page 41) should be wet with water to make a smooth paste and stirred into the spray, allowance having been made when putting water into the sprayer tank. It is of advantage to soak the arsenical some time ahead, because it mixes better with the Bordeaux when in the form of a smooth paste.

The 5-5-50 strength of Bordeaux is the best to use, tho good results have been found to follow the use of weaker mixtures.

Dusting: Insecticides in dust form (page 41) have been used for some years past with good success. Since controls for blight are effective only when complete covering is accomplished, applying Bordeaux in dust form is rather more difficult than dusting with arsenicals, where complete covering is not so essential. The effectiveness of dust applications of Bordeaux depends on the fineness of the dust and on the design of the duster. Results have been secured with dusting for blight control that compare favorably with those attending the spraying with Bordeaux mixture. As to time and labor saved, dusting is superior in that the weight of the water is eliminated; under conditions where water is scarce or where water hauls are long, dusting may be the only practicable way. Improvements in the manufacture of the dusts now on the market are desirable, to make their effectiveness greater and their price approximating that of wet Bordeaux.

Fig. 14. A Potato Duster in Action.

The selection of a dusting outfit deserves study. A good crank duster delivering a continuous stream can cover an acre in two hours and do a thoro job; the drawback to its use is that the nozzle is in front of the operator, who is therefore surrounded by a cloud of the dust. One-horse and two-horse traction-driven dusters of high efficiency are on the market; also those with engine-driven blowers. Any of these types, with feeds and nozzles properly adjusted and dust of proper composition and fineness, can be made to do a good job, whether applying Bordeaux dust or arsenicals and nicotine sulfate dust for insect control.

Wilt (and see page 47), often confused with drought injury, has a symptom by which it may be recognized in the field, namely, the yellowing or browning of the tissue immediately under the outer bark. It can be observed by pulling off downward, a leaf or branch in such a way that the outer bark strips off with it. A plant suffering with potato wilt produces, usually, only small potatoes especially when the infection takes place early, and in a backward season. If the percentage of wilt is low, pulling out infected plants will go far toward safeguarding the seed stock, but if the disease is general, a sign that the soil is infected, some other crop than potatoes had better be planted on that land. There is no cure for wilt in the field but freedom

from the disease so far as seed is concerned, may be practically assured if the seed potatoes are carefully examined and every tuber rejected which, when cut across near the stem end, shows any discoloration in the form of a brown ring. Ring discoloration is not always an indication of wilt but the grower cannot afford to take any chances in using such tubers for planting.

The "Running-Out Diseases: These include such ailments as curly dwarf, leaf roll, the mosaics, wilt, black scurf and spindle tuber.

Curly Dwarf: Curly dwarf is recognized by the short stature of the plant but bearing its normal number of leaves, giving it a rosetted appearance and its foliage much disordered. A plant suffering from curly dwarf usually yields only small potatoes. Digging such hills and removing the potatoes before the general digging will reduce the amount of the disease to be carried over in the seed, but pulling and removing the affected plants as soon as observed is very much better, for when this is done, spread of the disease by insects is lessened.

Mosaic: This disease has been separated into as many as six types, ranging from the form in which well-defined patches of pale color are seen on the foliage, thru that in which the leaves are undersized and deeply corrugated, to that in which the leaflets are faintly frilled or arranged slightly askew on the main leaf stem. There is no help for mosaic in the field, but if only a few plants are affected, and these are removed *as soon as the disease can be identified,* the potatoes remaining should be acceptable seed stock; *late pulling* of infected plants *is of little if any value.* A plant suffering from mosaic always bears potatoes under normal size and the more severe or earlier the infection, the smaller the potatoes.

Leaf Roll: The leaf roll disease may be confused with a rolling of the leaf caused by potato lice or by drought. To distinguish it from the former, it should be borne in mind that in leaf roll the leaves curl upward; when lice are responsible, they curl downward. To make certain of leaf roll disease as distinguished from curling caused by drought, it should be observed that in leaf roll the leaflets crackle and feel turgid when

squeezed in the hand; curled leaves caused by drought feel wilted and flaccid. The control for leaf roll is the same as for mosaic.

Spindle Tuber: The "spindle" or "run-out tuber" disease manifests itself in the field by a habit of growth very similar to that of a plant suffering from black scurf. A hill so affected will be found to have either several small tubers or one of good size, but in all cases the shape is abnormal. There may be found among them pear-shaped, jug-shaped and cylindrical tubers, the last named sometimes approaching the form of a cigar. These types should be avoided in selecting seed. Early removal of suspicious plants from the field is urged.

General Control: The control of these four diseases may be expected by observing the following precautions; sometimes a single one of them may suffice.

1. Do not use small seed potatoes, unless certain that they come from good hills.

2. Keep seed plots under close observation and pull out promptly all plants which appear subnormal in any way, to remove the chance of diseased progeny becoming mixed with tubers from healthy hills, with the further danger of their being replanted and multiplied; the earlier in the season the pulling is done, the better.

3. Control all insects, either by poisoning, by spraying or dusting with tobacco extract for lice, or by spraying with Bordeaux mixture as a repellant.

VARIETIES

The Early Varieties: Red Bliss, or Bliss Triumph. The tubers of this variety are symmetrical, with few and shallow eyes; their skin color is bright red. The tops are rather upright, making close planting possible. The quality is not of the best but the shapely tubers and early maturity of this variety sometimes outweigh this disadvantage. Further objections to it are a shy bearing habit and the tendency of the tuber when used for a fall crop to make a second growth. This variety is recommended only for very early planting, both because of its lack of quality as compared with some of the later varieties, and because of its extreme susceptibility to disease when planted so as to mature in the warm months.

Carman No. 3 produces oblong roundish tubers, somewhat flattened, with shallow eyes and generally desirable conformation. It branches freely and because of its rather recumbent habit of growth requires wider planting than Bliss. Carman shows a tendency to set too many tubers giving heavy yields in favorable seasons, but extremely disappointing ones in years when droughts occur. In seasons of rapid growth hollow potatoes are quite commonly found. The color of the tops is pale green, a probable indication of relatively low vigor in this variety. It appears to contract more than its due proportion of potato troubles and is particularly subject to blight. The quality is mediocre, but the high yields which this variety can produce in a good season, tend to offset the objections to it.

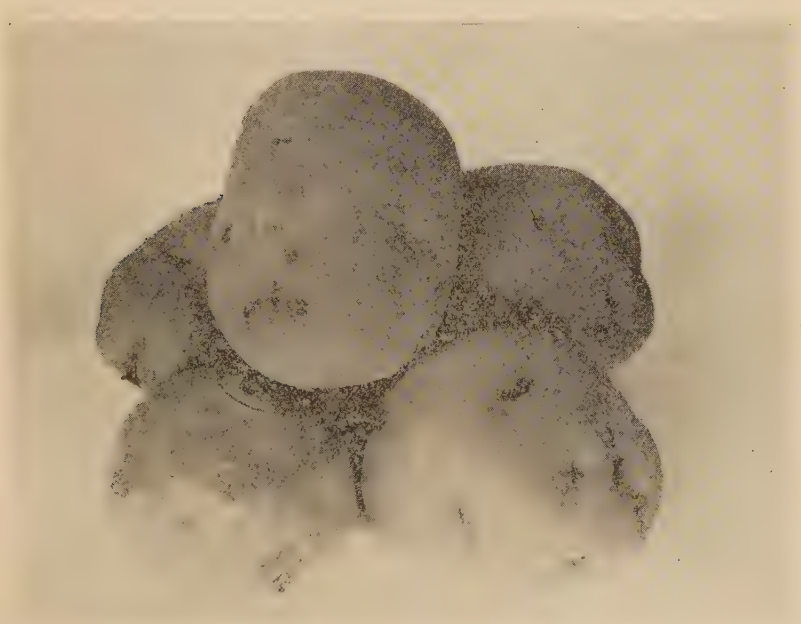

Fig. 15. Irish Cobbler.

Irish Cobbler is one of the varieties particularly suited to culture in this state. There are two types of tubers; one roundish

with a rather square stem end, the eyes set in depressions, and the bud cluster of eyes set on one side of the tip; the other cylindrical with eyes somewhat shallower, particularly those constituting the bud cluster. The habit of growth is upright, branching high, making very close planting possible. It is valued for its excellent quality and its ability to mature profitable crops either in the spring or fall, if the season is at all favorable. Taken by and large, Irish Cobbler is the best and safest variety to use in Kentucky.

Fig. 16. Early Ohio.

Early Ohio tubers are cylindrical, slightly flattened, shallow-eyed, and have a dull red skin. The variety makes moderate top growth of medium green color. It is a favorite in Ohio markets, which accounts for its rather general culture in the northern counties of Kentucky.

Its quality is fair in localities suited to it and its yield is satisfactory. Its main disadvantage is its tendency to make knobby tubers in seasons when second growth occurs.

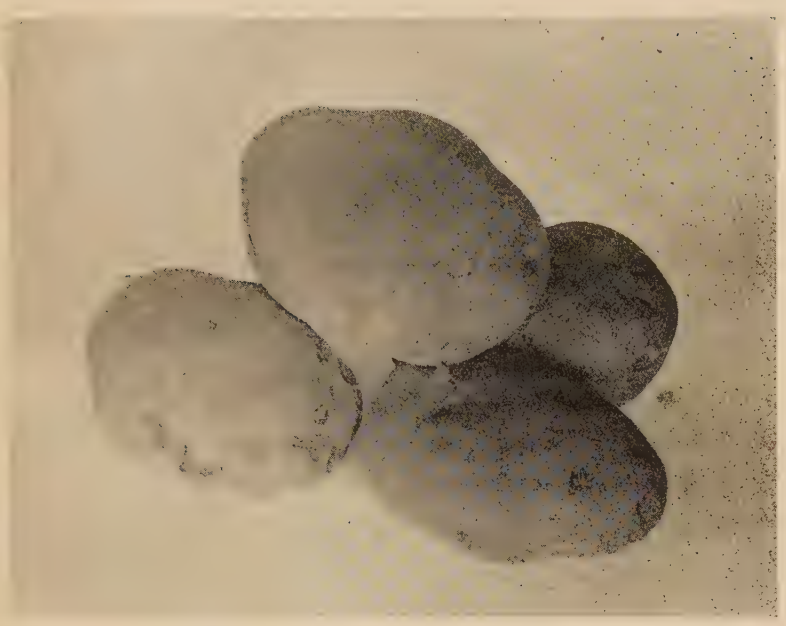

Fig. 17. Bull Moose.

The Late Varieties: Judging from its tuber shape alone the Bull Moose would appear to belong to or at least to be distantly related to the Green Mountain variety, but there the resemblance ends, for the Bull Moose makes much more vigorous top growth than Green Mountain and bears pink blossoms instead of white.

A point against Bull Moose is the difficulty in securing a good stand, due doubtless to the slow sprouting of the eyes on the stem end seed pieces, which are liable to rot, especially when planted in the hot and dry ground likely to be found at the planting time for this variety. Another disadvantage is that it sets its tubers only with the advent of cool weather, sometimes too late to mature a crop of large potatoes even tho this variety can survive much more cold and frost than Irish Cobbler and some others. The quality is excellent, especially when light has been kept from the tubers both at digging time and in stor-

age. In seasons when rains have been plentiful and killing frosts come late, Bull Moose is capable of making heavy yields, particularly when mosaic-free stock is used.

Fig. 18. Green Mountain.

Green Mountain is characterized by the symmetrical shape of its tubers, its few and shallow eyes, and by high quality. It is subject to blight rather early under Kentucky conditions, and its tender tuber skin makes it susceptible to scab. It sets its tubers, early, however, and in a season of favorable moisture conditions, when not cut down by an early frost, Green Mountain yields heavy crops.

The Russet Rural is of the Rural type, flattened oblong to roundish with tapered ends and with a skin distinctly russeted over a deep cream color. Its flesh, however, is white. The eyes are shallow and the quality very good. It appears to be especially adapted to a more northern climate than that of Kentucky,

Fig. 19. Russet Rural.

but it has shown promise under growing conditions suitable for Bull Moose. Its good points are its uniformity of tuber outline and size, and its quite satisfactory yields when moisture conditions are favorable.

The McCormick variety, or, better, the McCormick family, thrives in all parts of Kentucky. McCormick, or selections from it, bears several names, some authentic and some merely local disguises, such as Hoosier Boy, Late Hoosier, Peachblow (not Jersey Peachblow), Maggie Murphy (not the true Maggie Murphy), Mortgage Lifter, and the July potato. The tuber shape and eye depth of some of the selections are quite desirable, tho the gnarly appearance of some has done much to make McCormick and its derivatives slow sellers. The outstanding good points of the McCormick are the ease with which seed even in common storage, may be kept in good condition for late planting, and the heavy yield obtained regardless almost of season and

Fig. 20. McCormick.

of the care taken in the various steps of its culture. The tubers show a pronounced tendency to "green up" if left lying exposed after digging, and if their place of storage is not wholly dark. Very good practis is to cover them in storage with tarpaulin or with sacking so as to keep moving air from them, for they show proneness to becoming "strong" when this precaution is not taken.

In localities where cold storage for seed potatoes is not available, the McCormick family certainly holds an important place, and if reasonable care is taken to safeguard its quality, it is doubtful whether any other variety can be substituted for it.

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